E C O N O M I C S B U L L E T I N

Determinants of International Sound Recording Piracy

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Abstract

Examines the relative strength and significance of a range of institutional and economic variables thought to influence cross−country variations in sound recording piracy market share. Sound recording piracy imposes significant costs on copyright owners, including record companies, music publishers, recording artists and songwriters. The contribution of this paper is the central role allocated to the affordability index (the ratio of legitimate price to average hourly earnings) and to the balance of trade in sound recording product. The estimated regression model identifies a positive and significant relationship between sound recording PMS and the price−earnings (PE) ratio.

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1. Introduction

This paper explores the key factors thought to influence cross-country variations in sound recording piracy market share (PMS), which range from a low of 5% to 90% in the case of Australia and China respectively (IFPI, 2002). Sound recording piracy imposes significant costs on copyright owners, including record companies, recording artists and songwriters. While Internet piracy is a significant and growing phenomenon, physical sound recording piracy, which involves the mass production and smuggling of copyright infringing copies across national boarders, remains the dominant form of distribution in many countries. The International Federation of the Phonographic Industry (IFPI) estimated losses from music piracy to be valued at US$4.3 billion (IFPI, 2002).

The empirical analysis presented herein examines the relative strength and significance of a range of institutional and economic variables thought to influence country specific piracy levels. Previous empirical studies of piracy have examined the influence of copyright convention membership, GDP per capita, corruption in the civil service and the strength of private property rights (Burke, 1996; Marron and Steel, 2000; Ronkainen and Guerrero-Cusumano, 2001). The contribution of this paper is the central role allocated to the to the affordability index (the ratio of legitimate price to average hourly earnings) and to the balance of trade in sound recording product. The estimated regression model identifies a positive and significant relationship between sound recording PMS and the price-earnings (PE) ratio. The model also suggests a direct (but insignificant) relationship between the balance of trade and PMS.

2. International Sound Recording Piracy

Sound recording piracy market share is the proportion of the domestic market accounted for by pirate product. This is obtained by taking the ratio of pirate sound recording sales to total sound recording sales (that is, pirate plus legitimate sound recording sales). Since piracy leaves no paper trail we must rely on estimates of sound recording piracy. Estimates of copyright piracy are published by the International Intellectual Property Association (IIPA) and the IFPI. Table 1 presents country specific sound recording PMS estimates for 1998 and highlights the considerable cross-country variations. The key question investigated in this paper is: what are the key factors that cause such significant variation in sound recording PMS? First, a brief review of other studies is presented.

In an investigation of the relationship between international copyright conventions and piracy, Burke (1996) investigates the empirical validity of the contention that international copyright conventions were an effective means of curtailing sound recording piracy. In addition to convention membership and duration of membership, GDP per capita was included in the model to control for economic development. Economic development was expected to indicate "judicial and policing maturity" and be a reasonable proxy for institutional support for IPR enforcement (Burke, 1996:63). Burke concluded that economic development (GDP per capita) rather than membership to the international conventions is the most important factor distinguishing nations with low versus high piracy market shares. However, when comparing nations with medium and high piracy market shares, the copyright convention membership dummy, and not GDP per capita, was found to be positive and significant. In empirical studies of cross-country software piracy, a number of variables have been explored, including economic development, cultural factors, the strength of economic institutions, research and development intensity, education levels and trade dependence (Marron and Steel, 2000; Ronkainen and Guerrero-Cusumano, 2001). In the latter study, GDP per capita was used to proxy ability to pay, while in the former it was used to proxy the strength of institutions and the protection of intellectual property rights (IPR). By contrast the present study adopts more suitable proxies for these key factors.

Specifically, this paper examines the relative importance of the following factors: international copyright convention membership and membership duration, IPR enforcement, corruption in the civil service, expected profit, affordability and the balance of trade in sound recordings. These variables are discussed sequentially and the theoretical rationale for their inclusion in the regression model outlined.

2.1. Membership to International Conventions

Membership to an international copyright convention requires the signatory country to update domestic copyright laws to incorporate a set of minimum standards. As such, convention

membership is a proxy for the comprehensiveness of domestic IPR laws and is expected to have a negative association with piracy market shares. Following Burke (1996) we propose that membership to the Berne, Rome and Geneva conventions respectively will result in lower levels of PMS. Membership to these conventions can be ascertained by inspecting the register of each convention (maintained by the World Intellectual Property Organisation (WIPO)). For the purpose of estimating the regression model we assume a time lag of 5 years before convention membership will translate into a behavioural response at the market level and facilitate a reduction in piracy rates.

The model hypothesises that membership duration is inversely related to PMS. A comprehensive copyright act is a necessary but not sufficient condition for the eradication of piracy. The assumption underlying this hypothesis is that governments in convention member countries will allocate the necessary resources to monitor the commercial importation and distribution of copyright infringing sound recordings. A further assumption is that these laws are enforced by customs officers, the police and the judiciary, and that the appropriate penalties are imposed so as to provide an effective deterrent to this illegal trade. The issue of enforcement and corruption may therefore warrant closer attention.

2.2. Enforcement

It is proposed that higher levels of enforcement of IPR law lead to an increase in the probability of detection faced by smugglers of pirate product. This, in turn, increases the potential losses arising from the confiscation of infringing product and the imposition of financial penalties and/or a prison term. We therefore hypothesise a negative relationship between the level of enforcement and PMS. In the absence of a measure of copyright enforcement we use a proxy variable for the enforcement of IPR; an index of property rights. A government's commitment to the protection of physical property should provide a reasonable approximation of the likely level of protection of IPR. We can hypothesis that there is an inverse relationship between an index of private property rights and PMS. The property rights index measures the degree to which private property is protected and the degree to which a government enforces laws as they relate to private property. The index also incorporates a measure of the independence of the judiciary and the ability of individuals and businesses to enforce contracts (see Beach and O'Driscoll, 2001:57).[1]

2.3. Corruption

The model proposes that corruption in the customs authority, police and/or judiciary will result in a lower probability of detection and thereby, an increase in expected profit. That is, it is proposed that there is a direct relationship between the level of corruption in the civil service and the level of PMS. Kaufmann (et. al, 1999) construct a number of governance quality indicators. These indicators reflect the compilation of perceptions of the quality of governance derived from a survey of respondents in developing and industrialised countries alike, and includes responses from non-government organisations, commercial risk rating agencies and think tanks. The graft/corruption index is used as a proxy for the level of corruption in the civil service, including custom agents (armed with the responsibility of border controls) and the judiciary (police and prosecutors). Our empirical model proposes that the higher the level of corruption, the higher is PMS.

2.4. Expected Profit

For a given marginal cost of production and export price, expected profit will primarily depend upon the probability of detection, the nature and size of penalties and the quantity sold, which in turn, will be a function of the strength of demand for pirate sound recordings. The strength of demand for pirate sound recordings depends on a number of factors, including legitimate product price, consumer preferences and the price and quality of pirate product. The higher the legitimate product price, the larger is residual demand; the proportion of the market that is excluded from participating in the consumption of legitimate product. In turn, the larger the number of consumers excluded from participating in the formal market, the larger the potential size of the informal market. Once established, the informal market will also attract consumers from the formal sector. The size of the informal or black market sector will partly

[1] The better the level of protection the lower the index value (1 = very high protection) while a higher index number represents inferior protection (5 = very low protection).

determine the level of expected profit. This suggests that the existing size of the informal market within which pirate sound recordings are distributed, might be a suitable proxy for the strength of demand for pirate product and thereby, the level of expected profit. Our empirical model proposes that the higher the black market index (BM), the higher the piracy market share.

2.5. Balance of Trade in Sound Recording Product

By displacing relatively high priced legitimate product, pirate sound recordings can help improve the balance of trade with respect to copyright product. For a nation that is a net-importer of copyright product, smuggling of copyright infringing product can be welfare enhancing. This may help to explain why some governments officially oppose piracy but seemingly tolerate it unofficially. Sound recording royalty and license fee data is not available. The proxy variable chosen is total royalty and license fees recorded in the services account. This represents payments and receipts for the authorised use of intangible assets and property rights, such as copyright, trademarks and brand names. The data is obtained from the IMF *Balance of Payments Statistics Yearbook* (2000).[2] The model proposes that there is a direct relationship between the royalty and license fee trade deficit and PMS.

2.6. Affordability

Consumers, particularly those in low-income countries, might be priced out of the market for sound recordings. That is, legitimate product price will be set above the marginal valuation placed on sound recordings by many consumers. Marginal valuation is a function of both preferences and income. The model proposes that the higher the product price relative to income, the higher the level of piracy. We propose to measure affordability by taking the ratio of legitimate product price to average hourly earnings (the PE ratio) as illustrated in equation 1.[3] Our proxy variable for affordability is the price earnings index (PE):

$$PE = \frac{AverageSound\ \mathrm{Re}cording\ \mathrm{Pr}ice}{AverageHourlyManufacturingWage}(100) \qquad (1)$$

The empirical model proposes that there is a direct relationship between the PE ratio and PMS. For estimation purposes we chose to use the square root of the PE ratio. The rationale for this is that demand is expected to be more elastic the higher the price of the product relative to income. For low wage countries we expect the demand for pirate product to increase more than proportionately to an increase in the PE ratio and visa versa.[4]

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[2] There is however, a potential problem with using reported data on royalty and license payments. The displacement of legitimate sales will lower the value of import payments reported in the current account. For a net-importer of copyright product, high levels of piracy will have a significant beneficial effect on the balance of trade in copyright (lowering the deficit). Official data will therefore understate the true level of dependence of foreign copyright product. Accordingly, we use a weighted trade balance variable to compensate for this effect.

[3] Average price for full-price (Top 40 chart) sound recordings in the numerous countries included in the study are unavailable. The proxy used is the average sound recording price in each country. Data on sales volumes (units) and retail sales revenue is obtained from the IFPI publication *The Record Industry in Numbers* (1999). Average price is obtained by dividing total sales revenue by total sales volume for each country. The second component of the PE ratio is hourly earnings. Earnings vary greatly from one individual to the next. This earnings disparity is universal. To avoid this problem we use average hourly wage rates in manufacturing as our proxy variable for hourly earnings. Average hourly manufacturing wage rates are obtained from the International Labour Office (ILO), *Bulletin of Labour Statistics* (2000).

[4] A number of missing values for the *PE* variable were estimated by using a regional average *PE* ratio. For example, the missing value for Costa Rica was obtained by taking the Central American regional average *PE* ratio. The rationale for this procedure is that the use of regional averages (rather than the sample mean) provides a more accurate measure of affordability. These countries are at similar stages of economic development, have similar standard of living and wages, and relatively uniform sound recording prices (according to anecdotal evidence from various industry sources).

3. Model and Estimation Procedure

We assume that the true model is nested within a general model which we specify as:

$$PMS_i = \alpha + \beta B_i + \gamma YB_i + \lambda R_i + \nu YR_i + \eta G_i + \psi YG_i + \delta PR_i + \theta COR_i + \mu BM_i + \phi BOT_i + \kappa PE_i + \varepsilon_i \qquad (2)$$

where

PMS_i	=	piracy market share: the proportion of the market for sound recordings accounted for by pirate product
B_i	=	Berne convention membership dummy, i = 1, 0
YB_i	=	years of membership to the Berne convention
R_i	=	Rome Convention membership dummy, i = 1, 0
YR_i	=	years of membership to the Rome Convention
G_i	=	Geneva convention membership dummy, i = 1, 0
YG_i	=	years of membership to the Geneva convention
PR	=	Property rights index
COR_i	=	index of corruption
BOT_i	=	trade specialisation index
BM_i	=	index of black market activity
PE^2_i	=	ratio of the average price of legitimate product to average hourly manufacturing wages (squared)

The hypothesised signs of the coefficients are $\beta, \gamma, \lambda, \nu, \eta, \psi, \delta < 0$, while $\theta, \phi, \mu, \kappa > 0$. We estimate the empirical model using 1998 cross-section data on estimated sound recording piracy market shares in 84 countries. We have elected to use the IFPI data set for the estimation of our model. However, to increase the sample size we have included country specific PMS estimates from the IIPA data set not included in the IFPI data. This produces a sample size of 84 countries.[5]

Table 2 presents the estimated coefficients of the general model together with regression diagnostics. Inspecting Table 2 we find that the *t* statistics for the general model are mixed and range from relatively weak, in the case of the Berne membership regressor (*B*), to significant, in the case of the property rights index (*PR*) and the Geneva convention membership dummy (*G*). In estimating the specific model we apply a backward stepwise removal method, deleting at each step the variable with the weakest *t* statistic. The specific model generated from this procedure is presented in Table 2, along with diagnostic tests. The Property Rights index and Geneva Convention membership dummy are significant at the 1 percent level. Years of membership to the Berne convention is significant at the 5 percent level, while the PE ratio is significant at the 10 percent level.

Diagnostic tests for normality and multicollinearity are satisfactory. Table 2 also presents multicollinearity diagnostics, including Pearson correlation coefficients, eigen value conditional indices and variance inflation factors (VIF). In the absence of a critical value tests for hypotheses regarding multicollinearity, we rely on rules of thumb, which suggest the parsimonious model is not compromised by multicollinearity. The regression standardised residuals behave normally, with a standard deviation of 1.04 and a mean of –0.02. The Adjusted R^2 reveals that the specific model explains approximately 69 percent of the variation in cross-country PMS. Examination of the residuals statistics reveal only a relatively small proportion of predicted values lie outside the range of zero and 100.

Prior to discussing the preferred parsimonious model in greater detail we discuss the issue of suspected multicollinearity between the Corruption, Black Market and Property Rights indices. Pearson correlations coefficients for these variables range from 0.78 and 0.91. Other diagnostic tests for multicollinearity presented in Table 2 also suggest the existence of multicollinearity between these regressors. The existence of multicollinearity between independent variables can be dealt with by either dropping one or more of the "offending' variables or by constructing a composite index of the related variables.

Model (2) presented in Table 3 is estimated after dropping the *PR* regressor (which is highly correlated to both *BM* and *COR*) from the general model in an attempt to address the

[5] The correlation coefficient for the two estimates of piracy market share is 0.92, indicating that the two estimates are highly correlated. The similarity of the piracy estimates from two alternate sources provides greater confidence in the accuracy of the data and the methodology used by each organisation to estimate PMS across a range of divergent countries.

observed multicollinearity. Not unexpectedly, the *BM* regressor now enters the model and is significant at the 1% level. The PE^2 regressor enters Model (2) with a 5% level of significance, slightly stronger as compared with Model (1) where this regressor has a 10% level of significance. The alternative to dropping a correlated regressor is to construct a composite index of *COR, BM* and *PR*. Specific Model (3) replaces the *COR, BM* and *PR* indices with a composite of these variables, *INST*.[6] Not surprisingly, the *INST* regressor enters the Specific Model (3) as the most significant variable. Relative to Model (1), the PE^2 and *G* regressors remain relatively unchanged and are significant at the 5% and 10% level respectively. In conclusion, the alternate approaches of dropping a highly correlated independent variable versus constructing a composite variable is of little consequence to the overall results.

4. Results

The specific model reveals that an increase in the Property Rights index of 1 unit (signifying a deterioration in the level of protection) results in an 18 point increase in PMS. With a *t* statistic of 5.955, the Property Rights index is the most significant variable in the model. This is consistent with our hypothesis, which proposes that higher levels of IPR enforcement (low index value) are associated with lower levels of PMS. By comparison, Model (3) reveals that an increase in the composite index by one unit produces an increase in PMS by an average of 20.5 points. This provides support for our hypothesis that corruption in the civil service (customs control, judiciary and policing) would have a significant impact on the probability of detection, the risk:return ratio and the expected profit of the smuggling firm. The strength of the composite index regressor also provides support for the proposition that the size of black market operations in a country also impact directly with the level of observed PMS.

The model suggests that membership to the Geneva convention lowers PMS by 16.8 points. This is consistent with our hypothesis which proposes that membership to an international copyright convention will result in improved copyright protection in member country national markets and, thereby, lower PMS. As hypothesised we observe an inverse relationship between years of membership to the Berne convention and PMS. An increase in membership by 10 years lowers PMS by 1.6 points. While statistically significant at the 5 percent level, the size of the coefficient suggests that membership duration brings relatively modest improvements in domestic IPR protection. Considered together with the Geneva convention membership dummy, these results suggest that membership to an international copyright convention provide sizable short-term reductions in PMS (approximately 17 points) as national governments upgrade institutional support for IPR. Thereafter, relatively modest improvements in IPR protection can be expected as membership duration increases.

We observe a direct relationship between the PE ratio and PMS. This provides evidence for the hypothesis that the higher the price of legitimate sound recordings relative to income, the larger the level of residual (or unsatisfied) demand, and subsequently the level of piracy. This residual demand represents a market opportunity for distributors of pirate sound recordings. Consumers with marginal valuations below the legitimate price (reflecting, in part, low relative wage rates) can satisfy this unmet demand by purchasing relatively low priced pirate product.

5. Concluding Remarks

Our estimated regression equation is consistent with the predictions of our theoretical analysis. The positive relationship between the price-earnings ratio and piracy market share supports the hypothesis that piracy levels increase as sound recordings become less affordable for music enthusiasts. The higher the price-earnings ratio, the higher the residual demand for sound recordings. This residual demand represents a black market opportunity and raises expected profit for smugglers and distributors of pirate sound recordings. The model therefore lends support to our hypothesis that the higher the level of expected profit, the higher is piracy market share. Affordability, it would seem, is an important determinant of the relative level of estimated piracy market shares.

The model also predicted that the higher the level of corruption and black market activity, the higher the level of sound recording piracy. The significance of the composite index provides

[6] The individual indices had to be adjusted so that an increase in the *INST* index value corresponded to lower levels of IPR protection and higher levels of corruption and black market operations.

strong support for this hypothesis.[7] The model also supports the hypothesis that the better the level of protection of private property rights, and the degree to which government enforces these laws, the lower the level of sound recording piracy. In addition, we find support for the hypothesis of a direct (but relatively weak) relationship between foreign copyright dependence and PMS.

In conclusion, our model supports the proposition that both domestic and international institutions are important in influencing the level of sound recording PMS. A major contribution of our model is the inclusion of economic factors, specifically a measure of affordability and a nation's dependence on foreign copyright product. The regression model of cross-country variations in piracy market share is supportive of the numerous hypotheses examined. The implications are that copyright owner efforts to reduce sound recording piracy should focus not only on the efficacy of national government enforcement regimes, but also on pricing strategies, particularly in low income countries.

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[7] The logarithmic version of the estimated regression equation (not presented) provides strong support for this hypothesis, with the *BM* and *COR* regressors both significant at the 1% level in the parsimonious model.

Table 1 International Piracy Rates: 1998

Country	Piracy Market Share	Country	Piracy Market Share
Austria	5	Thailand	35
Belgium	5	Venezuela	35
Canada	5	Slovenia	37
Denmark	5	Israel	40
France	5	Poland	40
Germany	5	South Africa	40
Ireland	5	Saudi Arabia	45
Japan	5	Egypt	50
Netherlands	5	Kuwait	50
New Zealand	5	Latvia	50
Norway	5	Lithuania	50
Portugal	5	Mexico	50
Slovakia	5	China	56
Spain	5	Bulgaria	60
Sweden	5	Colombia	60
Switzerland	5	Hong Kong	60
UK	5	Malaysia	70
Czech Republic	6	Russia	75
Australia	7	Ukraine	75
USA	7	Bolivia	85
Indonesia	12	Estonia	85
Chile	17	Jordan	85
Finland	17	Peru	85
Hungary	17	Azerbaijan	90
South Korea	17	Romania	90
Singapore	19	Turkmenistan	90
Italy	20	Belarus	95
Philippines	20	Brazil	95
Greece	25	Kazakhstan	95
India	30	Pakistan	95
Turkey	30	Vietnam	99
Argentina	35		

Source: IIPA (1999)

Table 2 Sound Recording Piracy Model

Dependent Variable Piracy Market Share
Estimation Method Ordinary Least Squares

General Model	Coefficient	Std. Error	t-Ratio (Prob)	VIF
Intercept	3.415	13.687	.249 (.804)	
G	-21.194	11.371	-1.864 (.070)	4.944
YG	.483	.511	.944 (.351)	3.828
R	-5.116	8.958	-.571 (.571)	3.198
YR	.182	.374	.487 (.629)	2.405
B	1.696	10.771	.157 (.876)	1.629
YB	-.157	.097	-1.614 (.114)	2.301
PE^2	.295	.204	1.448 (.155)	2.021
COR	-2.008	5.895	-.341 (.735)	4.537
BM	1.682	4.105	.410 (.684)	4.530
PR	16.042	5.014	3.200 (.003)	3.809
BOT	0.001328	.001	1.366 (.180)	1.931
R^2	0.739			
Adj R^2	0.667			
F-stat	10.296 (0.00)			
S.E.	17.95			

N = 52

Table 3 Parsimonious Model

Dependent Variable Piracy Market Share
Estimation Method Ordinary Least Squares

Regressor	**Coefficient**	**S.E.**	**t-Ratio (Prob)**	**Eigen-value**	**Cond. Index**	**VIF**
Intercept	8.844	8.647	1.023 (.312)	3.653	1.000	
G	-16.812	5.218	-3.222 (.002)	.815	2.117	1.105
YB	-.158	.075	-2.094 (.042)	.300	3.487	1.459
PE^2	.336	.179	1.878 (.067)	.182	4.479	1.652
PR	18.084	3.037	5.955 (.000)	.0491	8.625	1.483

R^2	0.711
Adj R^2	0.687
F-stat	28.923 (.000)
SE	17.41

Residuals Statistics	**Minimum**	**Maximum**	**Mean**	**Std Deviation**
Predicted Value	-6.83	105.94	44.10	44.10
Residual	-64.47	40.63	-0.48	18.81
Std Predicted Value	-1.575	2.725	0.367	1.157
Std Residual	-3.702	2.333	-0.028	1.081

N = 84

Table 4 Summary Table: Specific Models

Dependent Variable Piracy Market Share
Estimation Method Ordinary Least Squares

Regressor	**(1)** [a]	**(2)** [a]	**(3)** [a]
Intercept	8.844 (1.023)	-2.882 (-0.349)	-7.468 (-0.931)
G	-16.82* (-3.222)		-14.314** (-2.607)
R		-13.005** (-2.156)	
YB	-0.158** (-2.094)		
PE^2	0.336*** (1.878)	0.432** (2.071)	0.347*** (1.851)
BM		9.729* (3.291)	
PR	18.084* (5.955)		
BOT		0.00231** (2.526)	
COMP			20.524* (6.243)
GDP			
N =	84	52	84
R^2	0.739	0.636	0.674
Adj R^2	0.667	0.605	0.654
SE	17.94	19.56	18.29
F (Sig)	28.923 (.000)	20.491 (.000)	33.127 (.000)

a. t-Ratios in brackets
* significant at the 0.01 level
** significant at the 0.05 level
*** significant at the 0.10 level

(1) Specific Model, as presented in Table 1
(2) Specific Model: after removing the *PR* regressor
(3) Specific Model: substituting the composite index (*COMP*) for *PR, BM* and *COR*